US Army Medical Cost Avoidance Model (MCAM) Health Hazard Assessment: Categories and Types*

Acoustic energy (steady-state noise, impulse noise, and blast over-pressure)

These hazards result from the potential energy that exists in a pressure wave that is transmitted through the air which may interact with the body to cause hearing loss or damage to internal organs. Hearing can be impacted by continuous noise from engines, environmental control units, helicopter rotors, and other steady-state noise sources. Hearing can also be impacted by impulse noise from shoulder-fired weapons, artillery, mortars, and other blast sources. Air-containing organs within the body can be impacted by blast over-pressure created from mortars, towed artillery, heavy weapons firing, and other blast sources. For details on data collection requirements, health effects, and medical criteria regarding this hazard, please access the following link on the Public Health Center's website for acoustic energy.

Biological substances

These hazards include exposures to microorganisms, their toxins, and enzymes, and addresses sanitation concerns such as bloodborne pathogen transmission, human waste disposal, food handling, water treatment and distribution, and personal hygiene. For details on data collection requirements, health effects, and medical criteria regarding this hazard, please access the following link on the Public Health Center's website for biological substances.

Chemical substances

These hazards arise from excessive airborne concentrations of mists, gases, vapors, fumes, or particulate matter. Exposure via inhalation, ingestion, skin contact, or eye contact may cause toxic effects. Hazards may also be caused by exposure to toxic liquids and solids by ingestion, skin contact, or eye contact. For details on data collection requirements, health effects, and medical criteria, please access the following link on the Public Health Center's website for chemical substances.

Radiation energy (Ionizing radiation, Nonionizing radiation (optical), and Nonionizing radiation (0-300 GHz))

These hazards include ionizing and nonionizing radiation. Ionizing radiation can cause ionization when interacting with living or inanimate matter and includes alpha and beta particles, gamma rays, x-rays, and neutrons. Nonionizing radiation refers to emissions from the electromagnetic spectrum that has insufficient energy to ionize molecules. This includes ultraviolet radiation, visible radiation, infrared radiation and radio frequency radiation. The Medical Cost Avoidance Model groups nonionizing radiation as being 0-300 gigahertz or optical. For details on data collection requirements, health effects, and medical criteria regarding this hazard, please access the following link on the Public Health Center's website for radiation energy.

Shock (acceleration and deceleration)

These hazards are a result of the delivery of a mechanical impulse or impact to an individual. This often results from individual contact with a medium that is accelerating or decelerating. Examples include the opening forces of a parachute harness and the forces delivered to the body as the result of weapon recoil. Shock hazards can result

in severe injury and performance degradation. . For details on data collection requirements, health effects, and medical criteria regarding this hazard, please access the following link on the Public Health Center's website for shock.

Temperature extremes (cold and heat)

These hazards include the human health effects associated with high or low temperatures (possibly in conjunction with high humidity), which may be exacerbated by the use of a materiel system. Cold-induced disorders include frostbite and hypothermia. Heat stress can result in heat disorders, such as heatstroke, heat exhaustion, heat cramps, and hyperthermia. For details on data collection requirements, health effects, and medical criteria regarding this hazard, please access the following link on the Public Health Center's website for temperature extremes.

Trauma (blunt, sharp, or musculoskeletal)

These hazards may occur from the impact of a sharp or blunt object to the eyes or body surface. Trauma to the musculoskeletal system may occur during the lifting of heavy objects, such as projectiles or ammunition boxes. . For details on data collection requirements, health effects, and medical criteria regarding this hazard, please access the following link on the Public Health Center's website for musculoskeletal trauma.

Vibration (whole-body and segmental vibration)

These hazards result from contact of a mechanically oscillating surface with the human body. Sources of whole-body and segmental vibration include riding in or driving vehicles and aircraft and operating certain hand-operated tools. Multiple shock, or "jolt," is a unique category of whole-body vibration that vehicle occupants can experience while riding in a vehicle over rough terrain. For details on data collection requirements, health effects, and medical criteria regarding this hazard, please access the following link on the Public Health Center's website for vibration.

*The Medical Cost Avoidance Model considers 8 health hazard categories and a total of in 17 health hazard types.

Health Hazard Assessment: Risk Assessment

Overview

The goal of the Health Hazard Assessment (HHA) effort is to support the acquisition leadership's risk management program to eliminate or control health hazards. The HHA Program uses the composite risk assessment approach to identify health hazards, demonstrate compliance with relevant occupational health exposure guidelines, and assess the level of risk associated with each hazardous situation. The result of the risk assessment process provides an estimate of the severity and probability of the adverse health effect likely to occur due to actual or predicted workplace hazard exposures. This risk characterization leverages risk management decision making and prioritization to reduce health risks to acceptable levels.

A health hazard is defined as the potential to cause illness or damage to health. It is important to distinguish between hazards inherent in normal operation and maintenance tasks and those hazards related to equipment failures, mishaps, or human errors. The scope of the HHA process includes assessment of inherent hazards during normal operation and maintenance, while the hazards related to failures or human errors fall within the scope of the system's safety program.

Military Standard (MIL–STD) 882 provides a standard practice to aid acquisition leadership in the management of environment, safety, and health risks encountered in the development, test, production, maintenance, use, and disposal of Department of Defense systems. This standard practice includes the use of risk assessment matrices to characterize assessed health hazards in terms that decision makers can use to set priorities as part of their overall risk management strategy. The standard also provides examples of risk assessment matrices that may be tailored to meet specific system requirements. A risk assessment matrix (Table 3), consistent with MIL–STD–882, is used for all HHAs unless a tailored system-specific matrix is provided.

Health hazard risk management

Health hazard assessments are based on scientific and objective criteria designed to communicate an independent medical assessor's (IMA) findings to other members of the Army acquisition community. Both qualitative and quantitative measures are used to determine the level of health risk associated with a specific health hazard. IMAs use the risk assessment code (RAC) process to define the severity and probability of a health hazard that could result from Soldiers' exposure to specific hazards, based on exposure scenarios. Risk is defined as the probability of an adverse health effect combined with the severity of the health effect.

Hazard severity

Hazard severity is an expression of magnitude of the most reasonable, credible, adverse, health outcome (occupational injury/illness) to a materiel system user or maintainer that will occur from exposure to a hazardous condition (physical, chemical, or biological) during normal use of the materiel system. Using the results of the HHA, the IMA assigns a hazard severity (HS) to each identified hazard, based on the categories outlined in Table 1.

Table 1. Health Hazard Severity Categories

Descriptive Word	Category	Description
Catastrophic	1	Hazard may cause death or total loss of a bodily system
Critical	2	Hazard may cause severe bodily injury, severe occupational illness, or major damage to a bodily system
Marginal	3	Hazard may cause minor bodily injury, minor occupational illness, or minor damage to a bodily system
Negligible	4	Hazard would cause less than minor bodily injury, minor occupational illness, or minor bodily system damage

Hazard probability

Hazard probability is an expression of the degree of likelihood that an exposure to a hazardous condition (physical, chemical, or biological) will produce the most reasonable, credible, adverse, health outcome to a materiel system user or maintainer based on an assessment of factors such as affected population, user scenario, and exposure duration and frequency. Hazard probability (HP) levels are assigned by a capital letter, as explained in Table 2.

Table 2. Health Hazard Probability Levels

Descriptive word	Level	Specific individual item	Fleet or inventory
Frequent	A	Likely to occur often	Continuously experience
Probable	B	Will occur several times in the life of an item	Will occur frequently
Occasional	C	Likely to occur sometime in the life of an item	Will occur several times
Remote	D	Unlikely but possible to occur in the life of an item	Unlikely but can reasonably be expected to occur
Improbable	E	So unlikely it can be assumed occurrence may not be experienced	Unlikely to occur, but possible
Eliminated	F	Incapable of occurring. This level is used when potential hazards are identified and later eliminated.	Not applicable

Risk assessment matrix

The IMA applies professional judgment to analyze the most reasonable, credible, adverse exposure scenario and characterizes the identified health risk by selecting an HS category and an HP level. After these have been selected, the assessor uses a risk assessment matrix to assign a RAC of High, Serious, Medium, Low or Eliminated. For example, HS of '1' and an HP of 'D' results in a RAC of 'Serious' using the standard risk assessment matrix shown in Table 3.

Table 3. Risk Assessment Matrix

RISK ASSESSMENT MATRIX				
SEVERITY / PROBABILITY	Catastrophic (1)	Critical (2)	Marginal (3)	Negligible (4)
Frequent (A)	High	High	Serious	Medium
Probable (B)	High	High	Serious	Medium
Occasional (C)	High	Serious	Medium	Low
Remote (D)	Serious	Medium	Medium	Low
Improbable (E)	Medium	Medium	Medium	Low
Eliminated (F)	Eliminated			

References:
Army Regulation 40-10, Health Hazard Assessment Program in Support of the Army Acquistion Process
Military Standard 882, Department of Defense Standard Practice: System Safety